

Amendments to the Claims

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1. (Currently Amended) A method for providing pacing therapy to a heart, comprising:  
~~establishing discrimination criteria for distinguishing different types of supraventricular tachycardia, including~~ establishing discrimination criteria for distinguishing at least two different types of supraventricular tachycardia having regular rapid supraventricular heart rates;  
sensing activity of at least one atria of the heart to provide an atrial activity signal;  
comparing at least one characteristic of the atrial activity signal to the discrimination criteria to identify one of the at least two different types of supraventricular tachycardia having regular rapid supraventricular heart rates ~~a type of supraventricular tachycardia occurring;~~ and  
controlling pacing of the heart in a first manner corresponding to the type of supraventricular tachycardia identified for an identified first one of the at least two different types of supraventricular tachycardia and in a second manner for an identified second one of the at least two different types of supraventricular tachycardia.

2. (Canceled). Previously canceled.

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3. (Currently Amended) The method of Claim 1 wherein establishing discrimination criteria ~~for distinguishing between at least two different types of regular rapid supraventricular heart rates~~ includes establishing criteria for distinguishing between fast atrial flutter and a slower rate supraventricular tachycardia.

4. (Previously Amended) The method of Claim 3 wherein establishing discrimination criteria includes establishing criteria for distinguishing between fast atrial flutter at a first high rate and a second atrial flutter at a second lower rate.

5. (Previously Amended) The method of Claim 1 wherein establishing discrimination criteria includes establishing rate-based discrimination criteria for distinguishing between different types of supraventricular tachycardia and wherein comparing at least one characteristic

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of the atrial activity signal to the discrimination criteria includes comparing a rate of the atrial activity signal to the discrimination criteria.

6. (Previously Amended) The method of Claim 1 wherein establishing discrimination criteria includes establishing morphology-based discrimination criteria for distinguishing between different types of supraventricular tachycardia and wherein comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes comparing a morphology characteristic of the atrial activity signal to the discrimination criteria.

7. (Previously Amended) The method of Claim 1 wherein establishing discrimination criteria includes establishing a multi-dimensional threshold function, and wherein comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes comparing a combination of a plurality of statistics calculated from a set of depolarization intervals determined from the atrial activity signal to the threshold function.

8. (Currently Amended) The method of Claim 1 further comprising monitoring an effect of controlling pacing of the heart in a manner corresponding to the type of supraventricular tachycardia identified, and automatically adjusting the discrimination criteria in response thereto.

9. (Currently Amended) The method of Claim 1 wherein controlling pacing of the heart in a manner corresponding to the type of supraventricular tachycardia and the regular rapid supraventricular heart rate identified includes providing atrial antitachycardia pacing to the heart for the identified first one of the at least two different types of supraventricular tachycardia or a second type of pacing control for the identified first one of the at least two different types of supraventricular tachycardia depending upon the type of supraventricular tachycardia identified.

10. (Previously Amended) The method of Claim 9 wherein the second type of pacing control is ventricular pacing.

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11. (Previously Amended) The method of Claim 10 wherein the second type of pacing control is selected from the group of pacing controls consisting of ventricular rate regulation and Rate Smoothing.

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12. (Previously Amended) The method of Claim 1 wherein comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes applying an atrial discrimination algorithm to the atrial activity signal to produce an atrial discrimination algorithm output value indicative of the type of supraventricular tachycardia occurring.

13. (Currently Amended) The method of Claim 12 comprising additionally trending a plurality of atrial discrimination algorithm output values and controlling timing of the pacing of the heart in a manner corresponding to the type of supraventricular tachycardia identified one of the at least two different types of supraventricular tachycardia in response to the trend of the atrial discrimination algorithm output values.

14. (Currently Amended) A method for providing pacing therapy to a heart, comprising :  
establishing discrimination criteria for distinguishing between regular rapid supraventricular heart rates, the regular rapid supraventricular heart rates including ~~distinguishing between~~ fast atrial flutter and a slower rate supraventricular tachycardia;  
sensing activity of at least one atria of the heart to provide an atrial activity signal;  
comparing at least one characteristic of the atrial activity signal to the discrimination criteria to identify whether a sensed regular rapid supraventricular heart rate is a fast atrial flutter of a slower rate supraventricular tachycardia is occurring; and  
controlling pacing of the heart to provide atrial antitachycardia pacing to the heart if a slower rate supraventricular tachycardia is identified as occurring and providing a second type of pacing control if a fast atrial flutter is identified as occurring.

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15. (Previously Amended) The method of Claim 14 wherein establishing discrimination criteria includes establishing criteria for distinguishing between the fast atrial flutter at a first high rate and a second atrial flutter at a second lower rate.

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16. (Previously Amended) The method of Claim 14 wherein establishing discrimination criteria includes establishing rate-based discrimination criteria for distinguishing between fast atrial flutter and a slower rate supraventricular tachycardia and wherein comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes comparing a rate of the atrial activity signal to the discrimination criteria.

17. (Previously Amended) The method of Claim 14 wherein establishing discrimination criteria includes establishing morphology-based discrimination criteria for distinguishing between fast atrial flutter and a slower rate supraventricular tachycardia and wherein comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes comparing a morphology characteristic of the atrial activity signal to the discrimination criteria.

18. (Previously Amended) The method of Claim 14 wherein establishing discrimination criteria include establishing a multi-dimensional threshold function, and wherein comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes comparing a combination of a plurality of statistics calculated from a set of depolarization intervals determined from the atrial activity signal to the threshold function.

19. (Previously Amended) The method of Claim 14 further comprising monitoring an effect of controlling pacing of the heart, and automatically adjusting the discrimination criteria in response thereto.

20. (Previously Amended) The method of Claim 14 wherein the second type of pacing control is ventricular pacing.

21. (Previously Amended) The method of Claim 20 wherein the second type of pacing control is selected from the group of pacing controls consisting of ventricular rate regulation and Rate Smoothing.

22. (Currently Amended) A method for distinguishing between different types of rapid regular supraventricular tachycardia, comprising:

establishing an atrial discrimination algorithm including discrimination criteria for distinguishing different types of rapid regular supraventricular tachycardia;

sensing activity of at least one atria of the heart to provide an atrial activity signal;

determining that an atrial rate is above a predetermined atrial tracking rate for performing ventricular pacing such that the atrial rate is higher than the ventricular rate;

in response to determining that the atrial rate is above the predetermined atrial tracking rate, applying the atrial discrimination algorithm to the atrial activity signal to compare at least one characteristic of said atrial activity signal to the discrimination criteria to identify a type of rapid regular supraventricular tachycardia occurring; and

providing an indication corresponding to the type of rapid regular supraventricular tachycardia identified.

23. (Previously Amended) The method of Claim 22 wherein establishing an atrial discrimination algorithm includes establishing discrimination criteria for distinguishing between fast atrial flutter and a slower rate rapid regular supraventricular tachycardia.

24. (Previously Amended) The method of Claim 22 wherein establishing an atrial discrimination algorithm includes establishing discrimination criteria for distinguishing between fast atrial flutter at a first high rate and a second atrial flutter at a second lower rate.

25. (Previously Amended) The method of Claim 22 wherein establishing an atrial discrimination algorithm includes establishing rate-based discrimination criteria for

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distinguishing between different types of rapid regular supraventricular tachycardia and wherein comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes comparing a rate of the atrial activity signal to the discrimination criteria.

26. (Previously Amended) The method of Claim 22 wherein establishing an atrial discrimination algorithm includes establishing morphology-based discrimination criteria for distinguishing between different types of rapid regular supraventricular tachycardia and wherein comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes comparing a morphology characteristic of the atrial activity signal to the discrimination criteria.

27. (Previously Amended) The method of Claim 22 wherein establishing an atrial discrimination algorithm includes establishing a multi-dimensional threshold function, and wherein applying the atrial discrimination algorithm to the atrial activity signal includes comparing a combination of a plurality of statistics calculated from a set of depolarization intervals determined from the atrial activity signal to the threshold function.

28. (Currently Amended) The method of Claim 22 ~~further comprising~~ wherein determining that the atrial rate is above the predetermined atrial tracing rate includes establishing a maximum atrial tracking rate, deriving ~~an~~ the atrial rate from an atrial activity signal, and comparing the derived atrial rate to the maximum atrial tracking rate, and wherein applying the atrial discrimination algorithm to an atrial activity signal is performed only if the derived atrial rate exceeds the maximum atrial tracking rate.

29. (Currently Amended) The method of Claim 22 further comprising controlling an atrial antitachycardia pacing therapy of a heart in a manner corresponding to the type for a first type of rapid regular supraventricular tachycardia identified and a ventricular pacing therapy for a second type of rapid regular supraventricular tachycardia.

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.116 – EXPEDITED PROCEDURE

Serial Number: 09/712600

Filing Date: November 14, 2000

Title: Method and Apparatus for Using Atrial Discrimination Algorithms to Determine Optimal Pacing Therapy and Therapy Timing

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30. (Currently Amended) A cardiac pacing device, comprising:  
sensing means for sensing activity of at least one atria of a heart;  
signal detection means coupled to the sensing means for generating an atrial activity signal based on the sensed activity of the at least one atria of the heart;  
a pacer for providing pacing pulses to the heart; and  
a processor coupled to the signal detection means for receiving the atrial activity signal and to the pacer for comparing at least one characteristic of the atrial activity signal to discrimination criteria for distinguishing at least two different types of regular rapid heart rates to identify a type of regular supraventricular tachycardia occurring and for controlling the pacer to provide pacing pulses a first pacing therapy to the heart ~~in a manner corresponding to the type of regular supraventricular tachycardia identified~~ for a first type of regular supraventricular tachycardia and a second pacing therapy to the heart for a second type of regular supraventricular tachycardia.

31. (Original) The cardiac pacing device of Claim 30 wherein the sensing means includes at least one electrode positioned in the heart and wherein the signal detection means is coupled to the electrode by a lead.

32. (Canceled). Previously canceled.

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33. (Currently Amended) The cardiac pacing device of Claim ~~32~~ 30 wherein the discrimination criteria include criteria for distinguishing between fast atrial flutter and a slower rate supraventricular tachycardia.

34. (Previously Amended) The cardiac pacing device of Claim 33 wherein the discrimination criteria include criteria for distinguishing between fast atrial flutter at a first high rate and a second atrial flutter at a second lower rate.

35. (Original) The cardiac pacing device of Claim 30 wherein the discrimination criteria include rate-based discrimination criteria for distinguishing between different types of supraventricular tachycardia and wherein the processor compares a rate characteristic of the atrial activity signal to the discrimination criteria to identify the type of supraventricular tachycardia occurring.

36. (Original) The cardiac pacing device of Claim 30 wherein the discrimination criteria include morphology-based discrimination criteria for distinguishing between different types of supraventricular tachycardia and wherein the processor compares a morphology characteristic of the atrial activity signal to the discrimination criteria to identify the type of supraventricular tachycardia occurring.

37. (Original) The cardiac pacing device of Claim 30 wherein the discrimination criteria include a multi-dimensional threshold function, and wherein the processor compares a combination of a plurality of statistics calculated from a set of depolarization intervals determined from the atrial activity signal to the threshold function to identify the type of supraventricular tachycardia occurring.

38. (Original) The cardiac pacing device of Claim 30 wherein the processor comprises additionally means for monitoring an effect of controlling the pacer to provide pacing pulses to the heart in a manner corresponding to the type of supraventricular tachycardia identified, and means for adjusting automatically the discrimination criteria in response to the monitored effect.

39. (Previously Amended) The cardiac pacing device of Claim 30 wherein the processor controls the pacer to provide atrial antitachycardia pacing to the heart or a second type of pacing depending upon the type of supraventricular tachycardia identified.



40. (Previously Amended) The cardiac pacing device of Claim 39 wherein the second type of pacing is ventricular pacing.

41. (Previously Amended) The cardiac pacing device of Claim 40 wherein the second type of pacing is selected from the group of pacing controls consisting of ventricular rate regulation and Rate Smoothing.

42. (Previously Amended) The cardiac pacing device of Claim 30 wherein the processor means for comparing at least one characteristic of the atrial activity signal to the discrimination criteria includes means for applying an atrial discrimination algorithm to the atrial activity signal to produce an atrial discrimination algorithm output value indicative of the type of supraventricular tachycardia occurring.

43. (Original) The cardiac pacing device of Claim 42 wherein the processor comprises additionally means for trending a plurality of the atrial discrimination algorithm output values and for controlling the pacer to control timing of the pacing of the heart in response to the trend of the atrial discrimination algorithm output values.

44. (Previously Amended) A cardiac pacing device, comprising:  
sensing means for sensing activity of at least one of the atria of a heart;  
signal detection means coupled to the sensing means for generating an atrial activity signal based on the sensed activity of the heart;  
a pacer for providing pacing pulses to the heart; and  
a processor coupled to the signal detection means for receiving the atrial activity signal and to the pacer for comparing at least one characteristic of the atrial activity signal to discrimination criteria for distinguishing between regular rapid supraventricular heart rates, including distinguishing between fast atrial flutter and a slower rate supraventricular tachycardia to identify whether a fast atrial flutter or a slower rate supraventricular tachycardia is occurring

and for controlling the pacer to provide atrial antitachycardia pacing to the heart if a slower rate supraventricular tachycardia is identified as occurring and to provide a second type of pacing if a fast atrial flutter is identified as occurring.

45. (Original) The cardiac pacing device of Claim 44 wherein the sensing means includes at least one electrode positioned in the heart and wherein the signal detection means is coupled to the electrode by a lead.

46. (Original) The cardiac pacing device of Claim 44 wherein the discrimination criteria include criteria for distinguishing between the fast atrial flutter at a first high rate and an other atrial flutter at a second lower rate.

47. (Original) The cardiac pacing device of Claim 44 wherein the discrimination criteria include rate-based discrimination criteria for distinguishing between fast atrial flutter and a slower rate supraventricular tachycardia and wherein the processor compares a rate characteristic of the atrial activity signal to the discrimination criteria to identify whether a fast atrial flutter or a slower rate supraventricular tachycardia is occurring.

48. (Original) The cardiac pacing device of Claim 44 wherein the discrimination criteria include morphology-based discrimination criteria for distinguishing between fast atrial flutter and a slower rate supraventricular tachycardia and wherein the processor compares a morphology characteristic of the atrial activity signal to the discrimination criteria to identify whether a fast atrial flutter or a slower rate supraventricular tachycardia is occurring.

49. (Original) The cardiac pacing device of Claim 44 wherein the discrimination criteria include a multi-dimensional threshold function, and wherein the processor compares a combination of a plurality of statistics calculated from a set of depolarization intervals determined from the atrial activity signal to the threshold function.

50. (Original) The cardiac pacing device of Claim 44 wherein the processor comprises additionally means for monitoring an effect of controlling the pacer to provide pacing pulses to the heart, and means for adjusting automatically the discrimination criteria in response to the monitored effect.

51. (Previously Amended) The cardiac pacing device of Claim 44 wherein the second type of pacing is ventricular pacing.

52. (Previously Amended) The cardiac pacing device of Claim 51 wherein the second type of pacing is selected from the group of pacing controls consisting of ventricular rate regulation and Rate Smoothing.

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53. (Currently Amended) An implantable cardiac device, comprising:  
sensing means for sensing activity of at least one atria of a heart;  
signal detection means coupled to the sensing means for generating an atrial activity signal based on the sensed activity of the at least one atria of the heart; and  
a processor coupled to the signal detection means for receiving the atrial activity signal and for applying an atrial discrimination algorithm including discrimination criteria for distinguishing different types of rapid regular supraventricular tachycardia to the atrial activity signal to compare at least one characteristic of the atrial activity signal to the discrimination criteria to identify a type of rapid regular supraventricular tachycardia occurring and for providing an indication corresponding to the type of rapid regular supraventricular tachycardia identified; and

a pacer for providing pacing pulses to the heart, wherein the processor is coupled to the pacer for controlling the pacer, wherein the pacer is dual chamber bradycardia pacer for providing pacing pulses to ventricles of the heart at a pacing rate based on a detected atrial rate up to a maximum atrial tracking rate and wherein the processor applies the atrial detection

algorithm to the atrial activity signal only if the detected atrial rate exceeds the maximum atrial tracking rate.

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54. (Original) The implantable cardiac device of Claim 53 wherein the sensing means includes at least one electrode positioned in the heart and wherein the signal detection means is coupled to the electrode by a lead.

55. (Original) The implantable cardiac device of Claim 53 wherein the atrial discrimination algorithm includes discrimination criteria for distinguishing between fast atrial flutter and a slower rate rapid regular supraventricular tachycardia.

56. (Original) The implantable cardiac device of Claim 55 wherein the atrial discrimination algorithm includes discrimination criteria for distinguishing between fast atrial flutter at a first high rate and an other atrial flutter at a second lower rate.

57. (Original) The implantable cardiac device of Claim 53 wherein the atrial discrimination algorithm includes rate-based discrimination criteria for distinguishing between different types of rapid regular supraventricular tachycardia and wherein the processor compares a rate characteristic of the atrial activity signal to the discrimination criteria to identify the type of rapid regular supraventricular tachycardia occurring.

58. (Original) The implantable cardiac device of Claim 53 wherein the atrial discrimination algorithm includes morphology-based discrimination criteria for distinguishing between different types of rapid regular supraventricular tachycardia and wherein the processor compares a morphology characteristic of the atrial activity signal to the discrimination criteria to identify the type of rapid regular supraventricular tachycardia occurring.

59. (Original) The implantable cardiac device of Claim 53 wherein the atrial discrimination algorithm includes a multi-dimensional threshold function and wherein the processor compares a combination of a plurality of statistics calculated from a set of depolarization intervals determined from the atrial activity signal to the threshold function to identify the type of rapid regular supraventricular tachycardia occurring.

60. (Canceled)

61. (Canceled)

62. (Previously Added) A cardiac pacing device, comprising:  
at least one sensor to sense atrial activity of a heart;  
a signal detector connected to the at least one sensor to generate an activity signal based on the sensed atrial activity of the heart;  
a pacer for providing pacing pulses to the heart; and  
a processor coupled to the signal detector to receive the atrial activity signal and coupled to the pacer to compare at least one characteristic of the atrial activity signal to discrimination criteria for distinguishing between regular rapid supraventricular heart rates, including distinguishing between fast atrial flutter and a slower rate supraventricular tachycardia to identify whether a fast atrial flutter or a slower rate supraventricular tachycardia is occurring and for controlling the pacer to provide atrial antitachycardia pacing to the heart for an identified slower rate supraventricular tachycardia and to provide a second type of pacing for an identified fast atrial flutter.

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63. (New) An implantable cardiac device, comprising:  
sensing means for sensing activity of at least one atria of a heart;  
signal detection means coupled to the sensing means for generating an atrial activity signal based on the sensed activity of the at least one atria of the heart; ~~and~~

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a processor coupled to the signal detection means for receiving the atrial activity signal and for applying an atrial discrimination algorithm to the atrial activity signal to compare at least one characteristic of the atrial activity signal to discrimination criteria, wherein the atrial discrimination algorithm is adapted to discriminate between a fast atrial flutter at a first high rate and an other atrial flutter at a second lower rate, and wherein the processor is adapted to provide an indication corresponding to an identified one of the fast atrial flutter at a first high rate and the other atrial flutter at a second lower rate.

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64. (New) A method for providing therapy to a heart, comprising:

- establishing discrimination criteria for distinguishing at least two different types of supraventricular tachycardia having regular rapid supraventricular heart rates;
- sensing activity of at least one atria of the heart to provide an atrial activity signal;
- determining that an atrial rate is above a predetermined atrial tracking rate for performing ventricular pacing such that the atrial rate is higher than the ventricular rate;
- in response to determining that the atrial rate is above the predetermined atrial tracking rate, providing an atrial discrimination therapy output based on the atrial activity signal, including comparing at least one characteristic of the atrial activity signal to the discrimination criteria to identify one of the at least two different types of supraventricular tachycardia having regular rapid supraventricular heart rates; and
- providing an atrial anti-tachycardia pacing therapy to the heart for an identified first one of the at least two different types of supraventricular tachycardia and providing a ventricular pacing therapy for an identified second one of the at least two different types of supraventricular tachycardia.

65. (New) The method of claim 64, further comprising:

- trending the atrial discrimination therapy output; and
- timing a pacing therapy based on the trended atrial discrimination therapy output.